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10/500,178	07/27/2004	Shigeaki Wachi	112857-373	5327

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EXAMINER	
YAKULIS, JEFFREY C	

ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
10/18/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/500,178	WACHI ET AL.	
	Examiner	Art Unit	
	Jeff Yakulis	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 August 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *49-69* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *49-69* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *25 June 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *8/9/2007*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. Claims 49-52, 53-54, 56-57, 63-69 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maget et al. (6,171,368) in view of Struthers et al. (6,620,537).

Regarding claim 49, Maget et al. teaches an electrochemical cell including a first electrode [110] for decomposing gas into ions, a second electrode [112] converting the ions generated in the first electrode into the gas again and an ion conductor [108 is ECM assembly] sandwiched in between both the electrodes; and a high pressure vessel disposed in one side of the electrochemical cell (figure 2B col. 5 lines 4-17 and col. 5 line 37-38), a low pressure vessel being disposed in the other side of the electrochemical cell, the electrochemical cell [108] serves as a gas partition wall and has a means for regulating pressure by controlling a potential between both the electrodes when a pressure difference is generated between both the sides of the electrochemical cell (figure 2B col. 5 lines 4-20 and col. 6 lines 48-59) but fails to disclose a hydrogen gas reservoir coupled to the high and low pressure vessel.

Struthers et al. teaches as system for evolving hydrogen from a hydrocarbon and then delivering the evolved hydrogen to a structure to hold and deliver hydrogen gas to the anode side of a hydrogen side of an electric power generating fuel cell (abstract). Struthers et al. teaches a hydrogen pressure tank [HT] being used as hydrogen fuel [31] being supplied to a fuel cell through lines [33, 34] through a hydrogen-metering pump [HMP] that delivers hydrogen to a fuel cell along with carbon dioxide and carbon monoxide. The carbon dioxide is then filtered out by column bed [F1] (col. 6 line 57 –

col. 7 line 5). Maget et al. teaches the extraction of gas using the electrochemical cell can be used in extracting oxygen/hydrogen from a mixture of gases essentially acting as a gas filter (col. 10 lines 21-27).

It would have been obvious to use the electrochemical pressure regulating device taught by Maget et al. in place of the hydrogen pump [HMP] taught by Struthers et al. used to extract hydrogen from a tank containing hydrogen, carbon monoxide, and carbon dioxide because it would allow for transport of just hydrogen to the fuel cell without carbon monoxide and dioxide being transported across the electrochemical cell thus eliminating the need for a column bed [F1] used to filter carbon monoxide and carbon dioxide allowing for simpler construction and easier maintenance of the system.

Regarding claim 50, Maget et al. teaches a means for supplying control current to both the ends of the first electrode [110] and the second electrode [112], wherein a quantity of the control current is controlled to control the flow rate of gas flowing across both the electrodes (col. 12 lines 53-62).

Regarding claim 51, Maget et al. teaches the ion conductor is a film made of an electrolyte material capable of permeating the ionized gas (col. 5 lines 6-20).

Regarding claim 52, Maget et al. teaches the first electrode [110] and the second electrode [112] are electrode films on which a catalyst capable of ionic equilibrium of the gas is carried (col. 11 lines 50-54).

Regarding claim 53, Maget et al. teaches a low pressure vessel being disposed in the other side of the electrochemical cell, the electrochemical cell [108] serves as a gas partition wall and has a means for regulating pressure by controlling a potential

between both the electrodes when a pressure difference is generated between both the sides of the electrochemical cell (figure 2B col. 5 lines 4-20 and col. 6 lines 48-59).

Regarding claim 54, Maget et al. teaches the force generated from the pressure difference is short-circuited or the pressure is regulated by a variable resistor (col. 4 lines 43-57; a variable resistor implies changing the direction of flow of electrons, which is done by the "controller").

Regarding claim 56, Maget et al. teaches both sides of the electrochemical cell serving as the gas partition wall have closed vessels, one side serves as a high pressure gas tank and the other side is connected to a gas consuming system (col. 5 lines 21-34), a pressure sensor is disposed in the closed vessel in the other side and the pressure sensor interlocks with a relay switch connected between both the electrodes of the electrochemical cell to function to compensate for the consumption of gas (col. 4 lines 38-62).

Regarding claim 57, Maget et al. teaches the electrochemical cell functioning as a gas refining filter (col. 10 lines 21-27).

Regarding claim 63, Maget et al. teaches an electrochemical cell [108] including a first electrode [112] for decomposing hydrogen gas into protons, a second electrode [110] for converting the protons generated into the hydrogen gas again, and a proton conductor sandwiched between the electrodes (col. 5 lines 4-19 and col. 7 lines 56-58); a high pressure vessel disposed in the first electrode side of the electrochemical cell to accommodate a gaseous material including the hydrogen gas (Figure 2B and col. 5 lines 37-39), while Maget et al. uses oxygen as an example it is noted to be applicable

to hydrogen (col. 7 lines 56-58), a gas consuming part including a pressure reducing part in which the electrochemical cell functions to reduce the pressure in the high pressure vessel (col. 5 lines 35-56) but fails to disclose: a third electrode disposed in contact with the hydrogen storage part to decompose the hydrogen gas supplied from the hydrogen gas storage part into protons, a fourth electrode for converting the protons generated into water, and a proton conductor sandwiched in between both the electrodes; the protons being converted into water in the fourth electrode to take out electrochemical energy between the third electrode and the fourth electrode.

Struthers et al. teaches as system for evolving hydrogen from a hydrocarbon and then delivering the evolved hydrogen to a structure to hold and deliver hydrogen gas to the anode side of a hydrogen side of an electric power generating fuel cell (abstract). Struthers et al. teaches a hydrogen pressure tank [HT] being used as hydrogen fuel [31] being supplied to a PEM type fuel cell (col. 7 lines 6-7,figure 1, third and fourth electrodes) through lines [33, 34] from a hydrogen-metering pump [HMP] that delivers hydrogen to a fuel cell along with carbon dioxide and carbon monoxide. The carbon dioxide and carbon monoxide is then filtered out by column bed [F1] (col. 6 line 57 – col. 7 line 5). Maget et al. teaches the extraction of gas using the electrochemical cell can be used in extracting oxygen/hydrogen from a mixture of gases (col. 10 lines 21-27).

It would have been obvious to use the electrochemical pressure regulating device taught by Maget et al. in place of the hydrogen pump [HMP] taught by Struthers et al. used to extract hydrogen from a tank containing hydrogen, carbon monoxide, and carbon dioxide because it would allow for transport of just hydrogen to the fuel cell

without carbon monoxide and dioxide being transported across the electrochemical cell thus eliminating the need for a column bed [F1] used to filter carbon monoxide and carbon dioxide allowing for simpler construction and easier maintenance of the system.

Regarding claim 64, Struthers et al. teaches hydrogen gas being delivered from a hydrogen tank [HT] to a PEM based fuel cell on one side of the electrode and compressed air [52] (oxygen containing) being delivered on the other side of the PEM type fuel cell creating energy and steam (water) being removed from the fuel cell by line [40] (col. 7 lines 65 – col. 8 line 10).

Regarding claim 65, Maget et al. teaches a decomposing step of decomposing gas into ions in a first electrode [112], a conducting step of conducting the decomposed ions to a second electrode [110] side through an ion conductor sandwiched between the first and second electrode, and a converting step of converting the conducted ions to the gas again in the second electrode [110] (col. 5 lines 4-17), but fails to disclose supplying hydrogen gas from a supply tank to a high pressure storage tank.

Struthers et al. teaches as system for evolving hydrogen from a hydrocarbon and then delivering the evolved hydrogen to a structure to hold and deliver hydrogen gas to the anode side of a hydrogen side of an electric power generating fuel cell (abstract). Gas containing hydrogen is transported from in a high pressure output stream [HPG2] and is collected in gas collecting zone [CC] where it is eventually delivered to hydrogen storage tank [HT] (col. 5 lines 35-57 and figure 1). Struthers et al. teaches a hydrogen pressure tank [HT] being used as hydrogen fuel [31] being supplied to a PEM type fuel cell (col. 7 lines 6-7,figure 1, third and fourth electrodes) through lines [33, 34] from a

hydrogen-metering pump [HMP] that delivers hydrogen to a fuel cell along with carbon dioxide and carbon monoxide. The carbon dioxide and carbon monoxide is then filtered out by column bed [F1] (col. 6 line 57 – col. 7 line 5). Maget et al. teaches the extraction of gas using the electrochemical cell can be used in extracting oxygen/hydrogen from a mixture of gases (col. 10 lines 21-27).

It would have been obvious to use the electrochemical pressure regulating device taught by Maget et al. in place of the hydrogen pump [HMP] taught by Struthers et al. used to extract hydrogen from a tank containing hydrogen, carbon monoxide, and carbon dioxide because it would allow for transport of just hydrogen to the fuel cell without carbon monoxide and dioxide being transported across the electrochemical cell thus eliminating the need for a column bed [F1] used to filter carbon monoxide and carbon dioxide allowing for simpler construction and easier maintenance of the system.

Regarding claim 66, Maget et al. teaches wherein a control current is supplied to both ends of the first and second electrode [110] to control a quantity of the control current so that the flow rate of rate of gas flowing across both the electrodes (col. 12 lines 53-62).

Regarding claim 67, Maget et al. teaches an electrochemical cell [108] including a first electrode [112], a second electrode [110], and an ion conductor serves as a gas partition wall and when a pressure difference is generated at both sides of the electrochemical cell, a potential between both electrodes is controlled to regulate.

Regarding claim 68, Maget et al teaches the electromotive force generated from the pressure difference is short-circuited or the pressure is regulated by a variable

resistor (col. 4 lines 43-57; a variable resistor implies changing the direction of flow of electrons, which is done by the "controller").

Regarding claim 69, Maget et al. teaches a high pressure gas storage tank is disposed at one side of the electrochemical cell [108] serving as the gas partition wall and a closed vessel connected to a gas consuming system is disposed at the other side (Figure 2B and col. 5 lines 21-34), a pressure sensor is disposed in the closed vessel in the other side and the pressure sensor interlocks with a relay switch connected between both electrodes of the electrochemical cell to function to compensate for the consumption of gas (col. 4 lines 38-62).

2. Claim 55 is rejected under 35 U.S.C. 103(a) as being unpatentable over Maget et al. (6,171,368) and Struthers et al (6,620,537) as applied to claim 49 above, and further in view of Kosek et al. (6,685,821).

Regarding claim 55, modified Maget et al. teaches all the limitations previously mentioned in claim 49 but fails to disclose: a plurality electrochemical cells are arranged in parallel in a gas flowing direction and has a multistage structure.

Kosek et al. is relevant because it is directed toward an electrochemical cell used for hydrogen storage (col. 1 lines 6-9). Kosek et al. teaches a plurality of electrochemical cells arranged in parallel in a gas flowing direction and having a multistage structure (figure 1-2, col. 2 lines 3-20 and col. 3 lines 30-55). Kosek et al. further teaches that this cell design is beneficial over previous hydrogen storage methods because it allows for safer operation and allows for a much simpler

construction of the cell itself thus providing for cost savings (col. 1 lines 44-48 and col. 2 lines 3-20).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to use the cell stack design discussed by Kosek et al. and apply it to the gas storage device of modified Maget et al. because it allows for a much simpler construction of the cell itself and is safer during operation thus allowing for cost savings.

3. Claims 58-62 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maget et al. (6,171,368) and Struthers et al (6,620,537) as applied to claim 49 above, and further in view of Hinokuma et al. (WO 01/06519).

Regarding claim 58, modified Maget et al. teaches all the limitations previously mentioned in claim 49 and teaches extracting gases from a container using an ion permeable membrane which, operates relying on the use of oxidation and reduction reactions occurring at either side of the electrochemical cell meaning the energy state of the gas changes by the loss and gain of electrons and further teaches the applicability of this device in reference to hydrogen gas allowing for the realization that the oxidation reaction of hydrogen gas: $H_2 \rightarrow 2H^+ + 2e^-$ essentially produces a proton, therefore the ion exchange membrane can also be a proton conducting membrane in light of what gas is being extracted (col. 5 lines 4-20 and col. 5 line 64) but fails to disclose: the composition of the ion/proton conductor being: formed with a derivative by introducing a proton dissociation group to carbon atoms forming a material which has, as a main component, at least a kind of material selected from a group including fullerene molecules, a cluster having carbons as a main component and a structural body having

tubular or linear carbons, and the prton generated in the first electrode is moved to the second electrode through the proton conductor.

Hinokuma et al. is relevant because it is directed toward an ion conductor used within a gas diffusion electrode. Hinokuma et al. teaches an ion conductor being a proton conductor, the proton conductor is formed with a derivative by introducing a proton dissociation group to carbon atoms forming a material which has, as a main component, at least a kind of material selected from a group including fullerene molecules, a cluster having carbons as a main component and a structural body having tubular or linear carbons, and the proton generated in the first electrode is moved to the second electrode through the proton conductor (pages 21-23). Hinokuma also teaches that water vapor can be produced during the operation of electrochemical cells when using standard membranes such as Nafion produced by Dupont. This would require the presence of a dehumidifier (pages 1-3). The necessity of a humidifier gives rise to problems associated with enlarging the scale of the cell and raises the cost of the sytem (pages 1-3). The old membrane further only allows for a limited operating temperatures (pages 1-3)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to substitute the membrane of Hinokuma et al. into the pressure reducing device of modified Maget et al. in order to provide for hydrogen compression without necessarily having to provide for a dehumidifier thus allowing for large scale systems to be produced, lowering the cost of the system, and an increased flexibility when choosing operating temperatures.

Regarding claim 59, Hinokuma et al. further teaches the proton dissociation group is –XH (X indicates an arbitrary atom or an atomic group having bivalent bonds and H indicates a hydrogen atom) (pages 21-23).

Regarding claim 60, Hinokuma et al. further teaches the proton dissociation group is –OH or –YOH (Y indicates an arbitrary atom or an atom group having bivalent bonds.) (pages 21-23).

Regarding claim 61, Hinokuma et al further teaches the proton dissociation group is a group selected from any of –OH, -OSO_3H, -COOH, -SO_3H, -$OPO(OH)_2$, and –C_6H_4-SO_3H (pages 21-23).

Regarding claim 62, Hinokuma et al. further teaches the fullerene molecules are spherical shell type carbon cluster molecules Cm (m indicates a natural number in which Cm may form a spherical shell structure) (pages 21-23).

Response to Arguments

Specification

With regards to the objection of the specification, due to amendment this objection is withdrawn.

Art Rejections

Applicant's arguments with respect to claims 49, 63, and 65 with regards to Maget et al. failing to disclose a hydrogen storage tank/vessel connected to a high pressure vessel have been considered but are moot in view of the new ground(s) of rejection necessitated by amendment.

Applicant's arguments with respect to claims 49 and 65 that Maget fails to disclose a gas pressure regulator have been fully considered.

The examiner respectfully disagrees. Maget et al. does teach regulating the pressure in the container by essentially ensuring the pressure is regulated as such that gas is continually extracted such that it remains zero within the container (col. 6 lines 13-32). Maget further teaches applying a current to both electrodes (figure 1 and col. 9 lines 59-65) such that gas flows through both electrodes ie. gas flows to one side of the electrochemical cell is oxidized transported through the ion exchange membrane and reduced at exits at the other side of the container (col. 5 lines 4-19).

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., pressure reducing and pressurizing device) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Applicant's arguments that Maget teaches away from the claimed invention have been fully considered.

The examiner respectfully disagrees. The gas extractor taught by Maget inherently has a pressure reducing and pressurizing means if provided within the system taught by Struthers et al. in place of the hydrogen metering pump. Electrochemical gas regulators as taught by Maget work according to the Nernst equation where an applied potential is proportional to a pressure differential across the

membrane. By adjusting the applied potential the pressure differential across the membrane can be adjusted and thus allow for regulation of the pressure. The reason Maget teaches an extraction device is because there is not a continual flow of oxygen into the container where extraction is occurring. However, if this extraction device were used in an area where it was exposed to a continual flow of gas such as a system taught by Struthers et al. with an appropriately applied potential it would work to regulate the flow of gas across the membrane.

Applicants arguments that Maget fails to disclose or suggest an electrochemical cell including a first electrode, a second electrode, and a **proton** conductor sandwiched between have been fully considered.

The examiner respectfully disagrees. Maget teaches extracting gases from a container using an ion permeable membrane, which operates relying on the use of oxidation and reduction reactions occurring at either side of the electrochemical cell meaning the energy state of the gas changes by the loss and gain of electrons. Maget teaches the applicability of this device toward hydrogen gas streams allowing for the realization that the oxidation reaction of hydrogen gas: $H_2 \rightarrow 2H^+ + 2e^-$ essentially produces a proton (H^+), therefore the ion exchange membrane can also be a proton conducting membrane in light of what gas is being extracted (col. 5 lines 4-20 and col. 5 line 64)

Conclusion

2. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Maget (5,788,682): clearly teaches an electrochemical gas regulation device (col. 3 line 65 – col. 4 line 5).

3. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jeff Yakulis whose telephone number is 571-272-9807. The examiner can normally be reached on M-F 9:30 AM-7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on 571-272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JCY
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